COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10EKO03**	**SEMESTER**	**6**
COURSE TITLE	**Quantum Mechanics II**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	5	7

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS247/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course offers students advanced knowledge of quantum mechanics and mathematical techniques for the solution of complex physics problems at atomic scales or lower.

Upon successful completion of the course, students will be:

- Capable of using the Dirac formalism.
- Familiar with the concepts of creation and destruction operators and their applications to the quantum simple harmonic oscillator as well as to a charged particle in a constant magnetic field.
- In command of mathematical and physical aspects of quantum angular momentum. In particular, students will know the algebra and states of angular momentum, for both orbital angular momentum and spin. They will also be able to add angular momenta and to calculate the Clebsch-Gordan coefficients.
- Able to analyze central potentials and will have solved the Schroedinger equation for Hydrogen-like atoms.
- Familiar with key physics phenomena (Zeeman effect, Stark effect, the fine and superfine structure of the Hydrogen atom).
- In command of the connection between spin and statistics, the interpretation of the Pauli exclusion principle, and its application to systems of identical particles.
- Capable of using basic approximation methods such as: time-independent perturbation theory, including for systens exhibiting degeneracy, and the variational principle.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

The course aims at the following general competences:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Analytical and synthetic thinking
- Problem solving

(3) SYLLABUS

- Dirac notation. Solution of the simple harmonic oscillator using creation and annihilation operators. The Schrödinger and Heisenberg pictures.
- Angular momentum and spin. Addition of angular momenta. Identical particles and Pauli exclusion principle.
- Interaction of charged particles with electromagnetic fields. Zeeman effect.
- Time-independent perturbation theory. The real hydrogen atom.
- Time evolution in time-dependent potentials. Elements of time-dependent perturbation theory. The Fermi golden rule.
- Introduction to three-dimensional scattering.
- Transitions between energy levels.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	Semester workload
Lectures	39
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	110
Course Total	**175**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek

(5) ATTACHED BIBLIOGRAPHY

- Κ. Ταμβάκης, Εισαγωγή στην Κβαντομηχανική, Leader Books, Μονοπρόσωπη ΕΠΕ, 2003.
- Σ. Τραχανάς, Κβαντομηχανική, Τόμος ΙΙ, ΙΤΕ Πανεπιστημιακές Εκδόσεις Κρήτης, 2009.
- S. Gasiorowitcz, (μετάφραση–επιστημονική επιμέλεια) Γ. Λαλαζήσης, Κβαντική Φυσική, Εκδόσεις Κλειδάριθμος, 2015.